

Appl. No. 09/805,849
Reply to Office Action of June 4, 2004

Docket No. RTN-100AUS

Amendments to the Claims:

This listing of the claims will replace all prior versions, and listings, of the claims in the application:

1 1. (original) A method for detecting incidents along a roadway comprising the
2 unordered steps of:
3 arranging a plurality of readers at intervals along a roadway for reading uniquely
4 identified data from each of a plurality of vehicles;
5 correlating the data with previously read data to obtain information on each of the
6 plurality of vehicles;
7 determining the number of vehicles potentially affected by incidents along the
8 roadway; and
9 comparing the number of vehicles potentially affected by incidents to a sample
10 threshold.

1 2. (original) The method of claim 1, wherein the plurality of readers comprises a
2 plurality of traffic probe readers.

1 3. (original) The method of claim 1, wherein each of the plurality of readers is spaced
2 at least five kilometers from an adjacent reader.

1 4. (original) The method of claim 1, wherein the information is at least one of:
2 a vehicle speed;
3 an expected vehicle travel time between two adjacent readers; and
4 an expected arrival time of each of the plurality of vehicles at one of the plurality
5 of readers.

1 5. (original) The method of claim 1, wherein the step of determining the number of
2 vehicles potentially affected by an incident further comprises the step of determining the
3 expected time for each of the plurality of vehicles to be detected by a particular one of the
4 plurality of readers.

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- 1 6. (original) The method of claim 5, wherein the step of determining the number of
2 vehicles potentially affected by an incident further comprises the steps of:
3 determining the amount of time each vehicle time is overdue past the expected
4 detection time; and
5 comparing an amount of time each vehicle time is overdue to a predetermined
6 threshold.
- 1 7. (original) The method of claim 6, wherein the predetermined threshold is adjusted
2 according to the roadway usage.
- 1 8. (original) The method of claim 5, wherein the step of determining the number of
2 each of the plurality of vehicles potentially affected by an incident further comprises the
3 steps of:
4 determining the amount of time each vehicle time is earlier than the expected
5 detection time; and
6 comparing an amount of time each vehicle time arrived early to a predetermined
7 threshold.
- 1 9. (original) The method of claim 8, wherein the predetermined threshold is adjusted
2 according to the roadway usage.
- 1 10. (original) The method of claim 1, further comprising detecting an incident in
2 response to the number of each of the plurality of vehicles potentially affected by an
3 incident exceeding the predetermined sample threshold.
- 1 11. (original) The method of claim 10, wherein each of the plurality of vehicles
2 potentially affected by an incident is overdue at one of the plurality of readers.
- 1 12. (original) The method of claim 10, wherein each of the plurality of vehicles
2 potentially affected by an incident has arrived early at one of the plurality of readers.

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1 13. (original) The method of claim 12, wherein the number of each of the plurality of
2 vehicles potentially affected by an incident is counted over a predetermined interval.

1 14. (original) The method of claim 4, wherein the arrival time of expected readings is a
2 function of the vehicle type.

1 15. (original) The method of claim 1, wherein the plurality of readers comprises a
2 transponder reader.

1 16. (original) The method of claim 1, wherein the plurality of readers comprises a
2 license plate reader.

1 17. (original) The method of claim 1 wherein an instantaneous speed of each of the
2 plurality of vehicles is determined by a Toll Gateway sensor.

1 18. (original) The method of claim 6, wherein the expected time for each of the plurality
2 of vehicles to be detected by reader is calculated by:

3
$$ExpSpeed[V_i, S_j] = \min(StartSpeed[V_i, S_j], HighSpeed[S_j])$$

4
$$ExpTime[V_i, S_j] = \frac{Length[S_j]}{ExpSpeed[V_i, S_j]}$$

5 where,

6 V_i is a vehicle entering a road segment S_j ;

7 $ExpTime[V_i, S_j]$ = expected time for V_i to be detected;

8 $StartSpeed[V_i, S_j]$ = starting speed of V_i at the beginning of segment S_j ;

9 $ExpSpeed[V_i, S_j]$ = expected speed over segment S_j ;

10 $HighSpeed[S_j]$ = average legal speed limit over the segment starting at S_j ;

11 and

12 $Length[S_j]$ = length of the segment starting at S_j .

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- 1 19. (original) The method of claim 18, wherein an overdue time for each of the plurality
2 of vehicles that has not been detected by the expected reader within the expected time, is
3 calculated by:

$$4 \quad \text{Overdue}[V_i, S_j, t_c] = \frac{t_c - \text{StartTime}[V_i, S_j] - \text{ExpTime}[V_i, S_j]}{\text{ExpTime}[V_i, S_j]} \times 100\%$$

5 where,

6 $\text{StartTime}[V_i, S_j]$ = time that V_i entered the segment starting at S_j .

- 1 20. (original) The method of claim 18, wherein a difference between the expected and
2 actual link travel time for each of the plurality of vehicles is calculated by:

$$3 \quad \text{Diff}[V_i, S_j] = \frac{\max\left(\text{ActualTime}[V_i, S_j], \frac{\text{Length}[S_j]}{\text{HighSpeed}[S_j]}\right) - \text{ExpTime}[V_i, S_j]}{\text{ExpTime}[V_i, S_j]} \times 100\%;$$

4 where:

5 $\text{ActualTime}[V_i, S_j]$ = actual time for V_i to travel over segment S_j .

- 1 21. (original) The method of claim 18, wherein the starting speed of V_i is calculated
2 by: $\text{StartSpeed}[V_i, S_j]$ = average speed of V_i over a prior segment.

- 1 22. (original) The method of claim 18, wherein the starting speed of V_i is calculated by:
2 $\text{StartSpeed}[V_i, S_j]$ = instantaneous speed of V_i at the start of S_j measured by a toll
3 gateway speed sensor.

- 1 23. (cancelled)

- 1 24. (original) The method of claim 1, further comprising the step of excluding each
2 vehicle, that is overdue for more than a predetermined cutoff threshold measured from
3 the time that the vehicle is initially overdue, from being counted in the number of each of
4 the plurality of vehicles potentially affected by incidents.

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1 25. (original) The method of claim 1, further comprising the step of excluding each
2 vehicle, that has arrived early at the end of a roadway segment for more than a
3 predetermined cutoff threshold measured from the time that the vehicle is initially early,
4 from being counted in the number of each of the plurality of vehicles potentially affected
5 by incidents.

1 26. (original) The method of claim 1, further comprising the step of suppressing the
2 detection of an incident in a roadway segment where the number of vehicles exiting the
3 segment of the roadway on an off-ramp over a predetermined interval of time exceeds a
4 predetermined threshold.

1 27. (original) A method for detecting incidents along a roadway comprising the
2 unordered steps of:
3 arranging a plurality of traffic probe readers at intervals along a roadway for
4 reading a transponder disposed on a vehicle;
5 correlating the transponder readings from each of the plurality of vehicles and
6 expected readings from each of the plurality of vehicles at more than one traffic probe
7 reader; and
8 detecting incidents which result in an interruption to the flow of traffic.

1 28. (original) The method of claim 27, further comprising the step of writing time and
2 location data into the transponder of each of the plurality of vehicles.

1 29. (original) The method of claim 27, further comprising the step of arranging a
2 plurality of toll gateways at intervals along a roadway for reading a transponder ID
3 disposed on each of a plurality of vehicles and for determining the presence of vehicles
4 not having a transponder ID.

1 30. (original) An incident detection system comprising:
2 a traffic management center processor connected to a data network;

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3 a plurality of unique vehicle data readers connected to said data network such that
4 uniquely identified data are read from each of a plurality of vehicles;
5 a correlation processor, wherein said uniquely identified data are correlated to
6 obtain a count of overdue vehicles and early arriving vehicles; and
7 an incident detection processor.

1 31. (original) The system of claim 30 wherein said plurality of unique vehicle data
2 readers further comprise:
3 a plurality of traffic probe readers, each of said plurality of traffic probe readers
4 having an automatic vehicle identification reader; and
5 a plurality of toll gateways, each of said plurality of toll gateways having an
6 automatic vehicle identification reader.

1 32. (original) The system of claim 30 further comprising a plurality of roadside toll
2 collection devices coupled to said plurality of toll gateways, said plurality of traffic probe
3 readers, and said traffic management center, such that the volume of data transmitted to
4 said traffic management center is minimized.

1 33. (original) The system of claim 30 wherein said correlation processor is connected to
2 said traffic management center processor.

1 34. (original) The system of claim 30 wherein said correlation processor is connected to
2 said roadside toll collection device.

1 35. (original) The system of claim 30 wherein said incident processor is connected to
2 said traffic management center processor.

1 36. (original) The system of claim 30 wherein said incident processor is connected to
2 said roadside toll collection device.